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OF

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Vol. VI FEBRUARY, 1919 No. 2

BOSTON SOCIETY OF CIVIL ENGINEERS

FOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

"The Operation of the Utilities at Camp Devens, Mass." Edward W. Briggs.

"Discussion of the Open-Air Treatment of Influenza." Charles F. Dingman.

Memoir of Deceased Member.

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Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

BINDING SOCIETY JOURNAL.

The Secretary has made arrangements for binding Volume 5 of the Journal of the Society. The ten numbers will be bound in one volume, the style of binding to be uniform with that of previous volumes. The price of binding this year will be $1.00 per volume.

Numbers for binding must be sent to 715 Tremont Temple, Boston, before April 1, 1919. After this date, numbers will not be accepted for binding except with the understanding that they cannot be bound at the price named.

MINUTES OF MEETING.

Boston, January 22, 1919. — A regular meeting of the Boston Society of Civil Engineers was held this evening at

Chipman Hall, Tremont Temple, and was called to order at 8 o'clock by the President, Charles M. Spofford.

There were 59 members and visitors present.

The record of the December meeting was read and approved.

The President reported for the Board of Government the election to membership in the grade of Member of Mr. Clarence Schuyler DePuy, and in the grade of Junior of Mr. Walter Augustine Woods.

The Secretary presented for Messrs. George A. King and Luther Dean, the committee appointed for the purpose, a memoir of Frank Albert Peirce, a member of the Society, who died August 7, 1917. The memoir was accepted and ordered printed in the JOURNAL.

The President announced the deaths of the following members of the Society, and the President was requested to appoint committees to prepare memoirs:

Harrie L. Whitney, who died October 14, 1918.
Charles C. Doten, who died December 28, 1918.
Past President Frederick Brooks, who died January 10, 1919.

Mr. John C. Chase said that the announcement of the death of Past President Brooks brought to his attention the small number of members of the Society remaining with us, who were responsible for the resuscitation of the Society in 1874, and he felt that some special recognition was desirable. While it might not be best to elect them all to honorary membership in the Society, he did think that they should be elected to some form of life membership.

He moved and it was so voted: That the Board of Government be requested to consider the propriety of making these members honorary or life members.

Mr. Hale brought to the attention of the meeting the existence of a committee appointed by the Board of Government to look out for the interests of engineers in any bills coming before the present legislature, and asked that this committee, of which he is chairman, be notified of any such proposed legislation known to any of our members.

The President then called on Mr. Robert Spurr Weston to read the paper of the evening, entitled "The Disposal of Sewage by Treatment with Acid," which had been prepared by him in conjunction with Mr. Edgar S. Dorr.

A discussion followed, in which the following took part: Mr. Harry W. Clark, chemist, Massachusetts Department of Health, and Messrs. Edgar S. Dorr, Almon L. Fales, Hartley L. White, George A. Carpenter and Robert Spurr Weston.

Adjourned.

S. E. Tinkham, *Secretary.*

APPLICATIONS FOR MEMBERSHIP.

[February 15, 1919.]

The By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

Dickson, Arthur Donohue, Cambridge, Mass. (Age 25, b. Cambridge, Mass.) Graduate of Mass. Inst. of Technology, 1917, civil engineering course, degree of B.S. Was office assistant and assistant foreman with George W. Macauley, builders' finish manufacturer, Boston, for period of year and a half before entering preparatory school; assistant superintendent of construction with Stone & Webster at Falls Village, Conn., during summer of 1916;

on entry of United States into the war, applied for commission in Coast Artillery Corps, Regular Army, and successfully passed examination for second lieutenant; has since been promoted to rank of captain, Regular Army; has recently resigned commission in order to follow engineering profession. Refers to J. B. Babcock, H. W. Hayward, G. L. Hosmer, J. W. Howard, E. F. Miller and C. M. Spofford.

McGovern, Patrick, New York, N. Y. (Age 47, b. Ireland.) Is contractor. Refers to F. H. Fay, C. R. Gow, J. W. Rollins, C. M. Spofford and S. Everett Tinkham.

Reeds, Clarence, Lowell, Mass. (Age 34, b. La Cygne, Kan.) Graduate of Univ. of Oklahoma, 1905, degree of A.B. in mathematics; graduate of Mass. Inst. of Technology, 1909, degree of S.B. in mechanical engineering. From June to September, 1909, with Engr. Dept. of associated Factory Mutual Fire Insurance Co., Boston; from September, 1909, to January, 1910, engineer with United Cork & Seal Co., Millis, Mass.; from January, 1910, to date, engineer with John A. Stevens, Cons. Engr., Lowell, Mass., on various engineering problems embodying analyses, original design and construction of power plants; has had charge of analyses of power, light and heating problems for General Electric Co.'s entire plants at Lynn, Mass., and Schenectady, N. Y.; has also had charge of design and supervision of construction of power plant revisions including 30,000 kw. steam plant for Turners Falls Power & Electric Co. at Chicopee, Mass. Refers to R. E. Barrett, W. W. Bigelow and G. H. Thorpe.

ROLL OF HONOR.*

ADDITIONS.

Sheils, Henry C. Ensign, Aviation Service, U. S. N., Inspector of Naval Aircraft, Keyport, N. J.

† Shute, George P. Captain, Q. M. C., Water and Sewer Section.

REVISIONS.

Bresth, Alexander. 1st Lieutenant, Sanitary Corps, U. S. A., Camp San. Engr., Camp Wadsworth, S. C.

Bussey, Byron C. 1st Lieutenant, U. S. A., 11 Star St., Pawtucket, R. I.

Coburn, William H. Captain, Gas Defense Div., Chemical Warfare Service, U. S. A., 19 West 44th St., New York, N. Y.

† Cowles, Martin W. 2d Lieutenant, Sanitary Corps, U. S. A., San. Squad, 9th Div., Camp Sheridan, Ala.

DeMerritt, Robert E. 1st Lieutenant, C. A. C., U. S. A., Fort Levett, Me.

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* Members who are in the service and have not yet reported that fact to the Secretary are earnestly requested to do so, stating branch of service, rank and military address.

† Home address given below in "List of Members."

DURHAM, HENRY W. Major, Engrs., U. S. A., Dept. of Const'n and Forestry, A. P. O. 717, Am. Ex. Force, France.

ELLSWORTH, SAMUEL M. Lieutenant, U. S. A., Sales Commissary, A. P. O. 762, Le Mans, France.

FERNALD, GORDON H. Captain, Co. D., 304th Engrs., Am. Ex. Force.

LEONARD, JOSEPH F. A. 1st Lieutenant, Engrs., U. S. A.; Officer in Charge, Engr. Sub-Depot, commanding 421st Engrs. (Depot), Camp Wadsworth, Spartanburg, S. C.

LUTHER, HOWARD B. Lieutenant, Const'n Corps, U. S. N. R. F., Bureau of Const'n and Repair, Navy Dept., Washington, D. C.

NASH, PHILIP C. Captain, Engrs., U. S. A., Washington Barracks, Washington, D. C.

PATSTONE, LEWIS F. Major, Engrs., U. S. A., Camp Humphreys, Va.

PHILLIPS, LAURENCE J. Sergeant, Co. C, 212th Field Signal Battalion, Camp Devens, Mass.

RICHMOND, CARL C. 1st Lieutenant, Co. A, 605th Engrs., A. P. O. 931, Am. Ex. Force.

SNOW, LESLIE W. Captain, Ordnance Dept., U. S. A., Rochester, N. H.

SPEAR, WALTER E. Major, Q. M. C., U. S. A., Utilities Officer, Camp Upton, N. Y.

TOSI, JOSEPH A. 1st Lieutenant, 28th MG Battalion, U. S. A., Camp Funston, Kan.

WARING, CHARLES T. Major, Supply Div., D. M. A., U. S. A., Wilbur Wright Air Service Depot, Fairfield, Ohio.

WRIGHT, EDWARD. Captain, Sanitary Corps, Camp San. Engr., Camp Benning, Columbus, Ga.

LIST OF MEMBERS.

ADDITIONS.

BERKOWITZ, S. ROSS....................Hotel Coolidge, Brookline, Mass.
DEPUY, CLARENCE S.,
War Dept., Const'n Div. of Army, Room 1-234, Washington, D. C.
WOODS, WALTER A....................19 Oxford St., Somerville, Mass.

CHANGES OF ADDRESS.

ALLBRIGHT, EDWIN F. ....568 Columbia Rd., Dorchester, Mass.
BAKER, LLOYD E.....................51 Congress Ave., Providence, R. I.
BARNES, T. HOWARD.......17 Battery Place, Room 1608, New York, N. Y.
BEAN, THOMAS W.....................180 Chestnut St., Holyoke, Mass.
BLAKE, EDMUND M...................Care Charles R. McCormick & Co.,
Fife Bldg., California and Market Sts., San Francisco, Cal.
BONNET, FREDERIC, Jr..............Care Atlas Powder Co., Landing, N. J.
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Carter, Clarence E. .... 23 Hanscom Ave., Reading, Mass.
Clark, Frederick, H. .... Camden, Me.
Cowles, Martin W. .... Mill Plain Rd., Fairfield, Conn.
Cross, Ralph U. .... 130 Burncoat St., Worcester, Mass.
Eisnor, John J. .... 60 Clarendon Ave., West Somerville, Mass.
Emerson, Ralph W. .... 51 North St., Pittsfield, Mass.
Forbes, Fred B. .... 541 State House, Boston, Mass.
Foster, Clarance L. .... 67 Thurston St., Somerville, Mass.
Gibson, Frederick M. .... 1906 Beacon St., Brookline, Mass.
Gillett, Laurence A. .... 718 Straley Ave., Princeton, W. Va.
Gregory, John H. .... Homewood, Baltimore, Md.
Grover, Nathan C. .... The Northumberland, Washington, D. C.
Gulesian, Selden J. .... 225 Endicott Ave., Revere, Mass.
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Horne, Ralph W. .... 90 Ashland St., Malden, Mass.
Horton, Freeman H. .... 1023 22d St. N. W., Washington, D. C.
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Hughes, Hector J. .... Harvard University, Cambridge, Mass.
Jones, Pusey .... Room 7-E, North Station, Boston, Mass.
Jonsberg, Frank F. .... 601-4 Old South Bldg., Boston, Mass.
Katz, Harry L. .... 925 Harlem Ave., Baltimore, Md.
Kearns, William F. .... Boston Army Supply Base,
Summer St. Extension, So. Boston, Mass.
Kerstein, Benjamin H. .... 20 Canterbury St., Dorchester, Mass.
Killion, Louis J. ... Care Monks & Johnson, 99 Chauncy St., Boston, Mass.
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Kirkpatrick, Charles D. .... 30 State St., Boston, Mass.
Kitfield, Edward H. .... 92 Water St., Boston, Mass.
Manley, Henry, Jr. .... 49 Lafayette St., New York, N. Y.
Manley, Laurence B.,
Dept. of City Transit, 1211 Chestnut St., Philadelphia, Pa.
Mann, William H. G. .... 95 No. Main St., Penacook, N. H.
Morris, Frank H. .... 95 Hudson St., Somerville, Mass.
Morse, William F. .... 10074 Keemar Park, Cleveland, Ohio
Negus, Arthur I. .... Care Charles H. Tenney & Co., Hampton, Va.
Newsom, Reeves J. .... 9 Portland St., Lynn, Mass.
Nichols, John R. .... 99 Chauncy St., Boston, Mass.
Peaslee, Dana N. .... 11 Cliffside Ave., Swampscott, Mass.
Preble, J. Jarvis .... 58 Howard St., Waltham, Mass.
Rice, Otis D. .... 19 Adams St., Winthrop, Mass.
Rich, Malcolm .... 155 Braddock Park, Boston, Mass.
Sauer, Fred E., Jr. .... 92 Trenton St., Melrose, Mass.
Scully, John T. .... 166 Devonshire St., Boston, Mass.

Sherman, Herbert L.,
Care Arthur D. Little, Inc., 30 Charles River Rd., Cambridge, Mass.
Shorrock, John W. .... Y. M. C. A., Newburyport, Mass.
Shute, George P. .... 1713 Baird Ave., Portsmouth, Ohio
Smith, Sidney .... 25 Garden St., W. Roxbury, Mass.
Smulski, Edward .... 15 East 40th St., New York, N. Y.
Stenberg, Thornton R. .... 416 Pierce Ave., Houston, Tex.
Sumner, Merton R. .... Care Fred T. Ley & Co., Inc., Springfield, Mass.
Thayer, Burdett C. .... 12 Farnsworth St., Boston, Mass.
Thomas, J. Franklin .... 50 Bromfield St., Boston, Mass.
Tucker, Francis C. .... 1938 Home Ave., Rogers Park, Chicago, Ill.
Vickery, Gilbert S. .... Care Bethlehem Steel Co., Steelton, Pa.
Wade, W. Newell ...... 1399 Commonwealth Ave., Suite 15, Allston, Mass.
Webb, George F. . . Care Supervising Engr., Camp Bragg, Fayetteville, N. C.
Wood, Henry B. .... 473–C State House, Boston, Mass.
Young, Erving M. .... 415 William St., Key West, Fla.

DEATHS.

Brooks, Frederick .... January 10, 1919
Doten, Charles C. .... December 28, 1918
Hayes, James, Jr. .... September 26, 1918

EMPLOYMENT BUREAU.

The Board of Government has established an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society room two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

Men Available.

438. Age 36. Received technical education at University of Maine. Has had twenty years' experience on sewer, water and highway work and general surveying. Desires position as chief-of-party. Salary desired, $35 per week.

439. Age 35. Graduate of Dartmouth College, degree of C.E. Experience covers five years' teaching of engineering subjects, one and one-half years as chief-of-party on subway construction, two years on supervision of construction, studies, plans and estimates for grade crossing eliminations,

New York, N. Y., and one year as chief-of-party and inspector on shipyard construction, including buildings, docks, pile-driving, reinforced concrete sewer and reinforced concrete shipways. Desires position as engineer or draftsman.

440. Age 33. Graduate of Norwich University, civil engineering course, degree of B.S. Has had about seven years' experience, chiefly in municipal work; has been rodman, transitman and for three years chief-of-party in responsible charge of all lines and grades of street construction; has done general city surveying, some drafting and some concrete design; has also had several months' experience as field engineer on army supply base. Desires either construction work or surveying. Salary desired, $25 per week.

441. Age 25. Experience consists of three years in field on federal valuation survey, as chainman, rodman and recorder, and ten months as Instrument Sgt. in 58th Field Artillery Regt., U. S. A. Will accept any position at reasonable salary; railroad work preferred.

443. Age 23. Graduate of Mass. Inst. of Technology, 1918, engineering adminstration course, mechanical engineering option. Has had three summers' experience, one with General Electric Co. in motor-winding and stock-room departments, one with blower and furnace company in machine shop and drafting room, and one selling specialties of aluminum cooking utensil company; has spent last eleven months in naval aviation service, having recently received inactive duty orders. Desires position with engineering concern, with opportunity to learn business and eventually work into administrative side. Salary desired, $25 per week.

444. Age 43. Graduate of Mass. Inst. of Technology, 1898, electrical engineering course. Experience covers ten years with firm of consulting engineers in Boston, as chief assistant to one member of firm on power plant investigations, reports and design, both steam and hydraulic, on appraisal work of street railways, etc.; was responsible for plant design of large and small hydraulic and steam developments; was for four years partner in firm of consulting engineers on domestic engineering, heating, ventilating, lighting, etc., and some larger plant work; recently discharged from U. S. Army as Lieutenant-Colonel, after serving on Mexican border and with 26th Division overseas. Desires position of responsibility or partnership, preferably in or near Boston.

LIBRARY NOTES.

RECENT ADDITIONS TO THE LIBRARY.

U. S. Government Reports.

Annual Report of Governor of Panama Canal for 1917-18.

Drainage Methods and Foundations for County Roads. E. W. James and others.

Effect of Grazing upon Western Yellow Pine Reproduction in Central Idaho. W. N. Sparhawk.

Fluorspar and Cryolite in 1917. Ernest F. Burchard.

Gypsum in 1917. Ralph W. Stone.

Magnesite in 1917. Charles G. Yale and Ralph W. Stone.

Manganese and Manganiferous Ores in 1916. D. F. Hewett.

Quaternary Geology of Southeastern Wisconsin. William C. Alden.

Quicksilver Deposits of Phoenix Mountains, Arizona. Frank C. Schrader.

Results of Observations Made at United States Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Maryland, 1915 and 1916. Daniel L. Hazard.

Results of Observations Made at United States Coast and Geodetic Survey Magnetic Observatory at Vieques, P. R., 1915 and 1916. Daniel L. Hazard.

Results of Spirit Leveling in New York, 1906 to 1911, inclusive. R. B. Marshall.

Santo Tomas Cannel Coal, Webb County, Texas. George H. Ashley.

Small Sawmills, their Equipment, Construction and Operation. Daniel F. Seerey.

Spirit Leveling in Illinois, 1914 to 1917, inclusive. R. B. Marshall.

Spirit Leveling in Kentucky, 1914 to 1916, inclusive. R. B. Marshall.

Structure and Oil and Gas Resources of Osage Reservation, Oklahoma, Parts A-N. David White and others.

Water-Supply Papers 412, 428, 432, 433, 435, 441, 465.

State Reports.

Maine. Report of Public Utilities Commission on Special Water Power Investigation, 1918.

New Hampshire. Biennial Report of State Highway Department for 1917–18.

New York. Annual Report of Public Service Commission for First District for 1916, Vol. I, Appendices A to F. Vols. II and III.

County Reports.

Wayne County, Mich. Annual Report of Road Commissioners for 1917–18.

Municipal Reports.

Albany, N. Y. Annual Report of Bureau of Water for 1917.

Gloucester, Mass. Annual Report of Water Commissioners for 1917.

Lynn, Mass. Annual Report of Commissioner of Water and Water Works for 1917.

Melrose, Mass. Annual Report of Public Works Department for 1917.

Miscellaneous.

American Society for Testing Materials: Proceedings for 1918, 2 vols. Gift of L. C. Wason.

American Society of Civil Engineers: Transactions for 1918. Vol. LXXXII.

Carnegie Foundation for Advancement of Teaching: Study of Engineering Education. Charles Riborg Mann. 1918. Gift of Desmond FitzGerald.

Cost of Power in State of Maine. (Reprinted from Special Water Power Investigation, Public Utilities Commission, State of Maine, 1918.) H. K. Barrows. Gift of author.

League to Enforce Peace: Win the War for Permanent Peace. William Howard Taft and others.

On the Road to Democracy. Alberto J. Pani.

Plumbing and Household Sanitation. J. Pickering Putnam. Gift of author.

LIBRARY COMMITTEE.

Vol. VI FEBRUARY, 1919 No. 2

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

THE OPERATION OF THE UTILITIES AT CAMP DEVENS, MASS.

By Major Edward W. Briggs.*

Ordinarily in building a city to accommodate a population of 40 000, considerable time would be spent in the selection of a site, in careful surveys of the land, in town planning and in preparation of building plans; but, in the emergency in which all the camps were built, time was the one important factor. Practically no information was available, either in this country or abroad, as to the requirements of these semi-permanent cantonments. Some slight information was obtained as to water allowance of the English and French armies, which, however, was far less than the 55 gals. per capita estimated necessary for our camps.

Considerable astonishment was expressed by many of the foreign officers attached for training purposes at the conveniences provided, but the wonderful results obtained in training men quickly and efficiently in a short time has quite evidently justified the expense of the complete systems installed. It must be remembered that the vast majority of these men who were selected to serve in our armies were accustomed to modern conveniences to be found in cities, the lack of which would have been a real hardship and undoubtedly would have affected the health and morale of these embryo soldiers. After a period of six months' scientific training, men were developed to an extent permitting active work in the field without hardship or ill effect.

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* Officer in charge of Camp Utilities, Camp Devens, Mass.

Note. — This paper will not be presented at a meeting of the Society, but discussion is invited, to be received by W. L. Butcher, Editor, 715 Tremont Temple, Boston, before April 10, 1919, for publication in a subsequent number of the Journal.

Much has been written about the construction of all the camps, Devens receiving its share, but only after a year of operation does one realize how wonderfully well the hasty plans and construction have served the purpose for which the camps were intended. The location has proved fortunate, is fairly easy of access to the city of Boston, about thirty-seven miles distant, with sand and gravel soil, although rather broken terrain, good water and natural sand-filter sewage disposal, ample railroad facilities, and, also of importance, land of low commercial value.

The entire Reservation contains about 10 000 acres, of which about 2 000 is occupied by the camp proper.

Originally, buildings to accommodate an entire company of 200 men, with kitchen and messing facilities, were designed, but a slight increase in the allotment from 40 to 50 sq. ft. per man, and an increase of the size of the companies, reduced the capacity of the buildings to 150 men each, necessitating construction of overflow barracks. The typical plan provides a two-story frame building, size 43 x 140 ft., including kitchen and mess hall with chestnut foundation posts, novelty siding, square-edged board roof covered with two-ply rubberoid and the interior lined with wall-board.

In general the barracks have proved satisfactory when the floor loads have been equally distributed, although the cost of maintenance and repair of buildings of this type has naturally been high. There are, of course, buildings of many other types, such as officers' quarters, small detachment buildings, storehouses, etc., all of which are one-story, but, instead of novelty siding, are covered with tar paper with battens.

Each company, detachment, or officers' quarters is provided with a lavatory 20 ft. distant from the barracks and provided with ample toilet and bathing facilities. The lavatory serving each 150-man barracks contains 12 flush bowls, 20 shower heads, urinal troughs, and hot water for bathing is continuously furnished, the officers' quarters and the few small detachment buildings having smaller lavatories, to suit the requirements of the occupants. In the small section which is not heated by steam, hot-water heaters are provided in the lavatories. The camp contains 15 central heating plants, 44 individual heating plants, 360 lavatories, 98 buildings for officers' quarters, 277 barracks for enlisted men, a bakery, a post-office, a refrigerating plant, a laundry, 3 pumping stations, 1 substation, 4 fire stations, 2 grain elevators, one being located at the remount station, an incinerator plant, 25 medical infirmaries, numerous schoolhouses and many large buildings devoted to recreational purposes. Attached to the camp is a complete base hospital of 1 840 beds, which are placed in large wards, 33 of which are one-story, being ordinarily 24 ft. wide and approximately 150 ft. long; and 12 two-story convalescent wards, which in size are 24 ft. by 156 ft. Six large nurses' quarters are provided, a chapel and mortuary. A remount station, for 6 000 animals, is attached to the camp and contains barracks for its personnel, corrals, hay sheds, shelters, etc.

Soon after the arrival of troops it became quite evident that the operation of the various utilities and maintenance and repair of the camp required a well-organized force. Authorization was received, and after rather strenuous efforts on the part of the lone officer placed in charge, some semblance of an organization was formed by transferring soldiers from the line companies to the Camp Utilities Detachment, but it was not until January 1, 1918, that any serious attempt could be made to follow a rather hastily formed operating plan. The organization, however, proved its efficiency last winter when the slogan of "continuous service" was justified, although it must be confessed that a winter of extremely low temperature, resulting in frost over five feet in depth, frequently caused consternation. The officers, with few exceptions, were promoted from the enlisted personnel, and at present the commissioned personnel consists of the following:

Major Edward W. Briggs, officer in charge; 1st Lieut. Avery R. Schiller, executive officer and in charge electrical distribution; 1st Lieut. Edward C. Oldhan, in charge of electrical operation and survey officer; 1st Lieut. James H. Reynolds, in charge of water and sewers and transportation; 2d Lieut. Edwin H. Burkhardt, in charge of plumbing; 1st Lieut. John V. Boyle, in charge of buildings and roads; 2d Lieut. Adolph J. Post, road engineer; 1st Lieut. Francis Cunningham, in charge of heating and post exchange; 2d Lieut. James L. Bride, assistant officer in charge of heating and adjutant; 2d Lieut. John M. Harrington, fire chief; Capt. Walter E. Brown, in charge of property and supplies.

In addition to the ordinary duties of operation, each officer is responsible for his share of the company administration, such as clothing, mess, discipline, etc., for the enlisted force of 850 men.

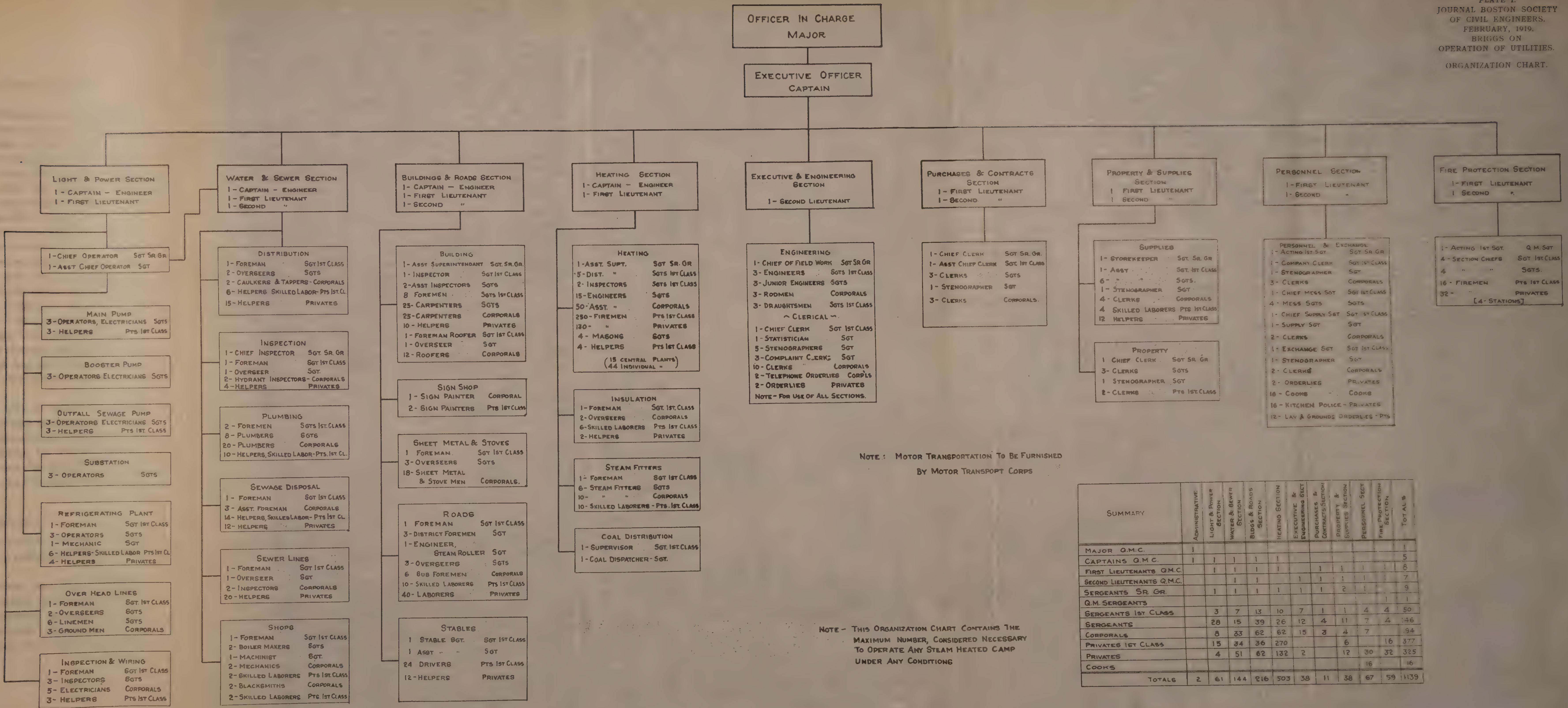
By comparing the camp with a city of 40 000 population, some idea may be had of the difficulties encountered in furnishing, not only ordinary water, sewer and lighting services, but delivering continually hot water for bathing, steam heat for buildings, electric lights, and at the same time keeping buildings and systems in repair. It is amazing how quickly a $1\frac{1}{8}$-in. hard-pine stair tread can disappear when used by 150 husky young men shod with hobnail shoes.

Careful consideration at the time of organizing the force was given not only to the operation of utilities, but also to the maintenance and repair which was expected to be high owing to the type of buildings and the number of occupants. With very few changes, after a year of operating, the organization stands as originally conceived, and consists of the following sections which function through the executive office to the officer in charge: Light and power, heating, buildings and roads, water and sewers, executive and engineering, purchases and contracts, property and supplies, personnel, fire protection.

Plate I shows the detail of the organization, but the officers and men listed on the organization chart are considered the maximum number which would be required under any conditions. This organization has operated with considerable success with 11 officers and about 850 men, although the work could have been performed more efficiently and with less responsibility on officers had it been possible to secure an organization

PLATE I.
JOURNAL BOSTON SOCIETY
OF CIVIL ENGINEERS.
FEBRUARY, 1919.
BRIGGS ON
OPERATION OF UTILITIES.

ORGANIZATION CHART.



Officer In Charge
Major

Executive Officer
Captain

Light & Power Section
1 - Captain - Engineer
1 - First Lieutenant

1 - Chief Operator	Sgt Sr Gr
1 - Asst Chief Operator	Sgt

Main Pump

3 - Operators, Electricians	Sgts
3 - Helpers	Pts 1st Class

Booster Pump

3 - Operators Electricians	Sgts

Outfall Sewage Pump

3 - Operators Electricians	Sgts
3 - Helpers	Pts 1st. Class

Substation

3 - Operators	Sgts

Refrigerating Plant

1 - Foreman	Sgt 1st Class
3 - Operators	Sgts
1 - Mechanic	Sgt
6 - Helpers - Skilled Labor	Pts 1st Cl
4 - Helpers	Privates

Over Head Lines

1 - Foreman	Sgt. 1st Class
2 - Overseers	Sgts
6 - Linemen	Sgts
3 - Ground Men	Corporals

Inspection & Wiring

1 - Foreman	Sgt 1st Class
3 - Inspectors	Sgts
5 - Electricians	Corporals
3 - Helpers	Pts 1st Class

Water & Sewer Section
1 - Captain - Engineer
1 - First Lieutenant
1 - Second "

Distribution

1 - Foreman	Sgt 1st Class
2 - Overseers	Sgts
2 - Caulkers & Tappers	Corporals
6 - Helpers Skilled Labor	Pts 1st. Cl.
15 - Helpers	Privates

Inspection

1 - Chief Inspector	Sgt. Sr. Gr
1 - Foreman	Sgt 1st Class
1 - Overseer	Sgt.
2 - Hydrant Inspectors	Corporals
4 - Helpers	Privates

Plumbing

2 - Foremen	Sgts 1st. Class
8 - Plumbers	Sgts
20 - Plumbers	Corporals
10 - Helpers, Skilled Labor	Pts. 1st. Cl.

Sewage Disposal

1 - Foreman	Sgt 1st Class
3 - Asst. Foreman	Corporals
14 - Helpers, Skilled Labor	Pts 1st Cl
12 - Helpers	Privates

Sewer Lines

1 - Foreman	Sgt 1st Class
1 - Overseer	Sgt
2 - Inspectors	Corporals
20 - Helpers	Privates

Shops

1 - Foreman	Sgt 1st Class
2 - Boiler Makers	Sgts
1 - Machinist	Sgt.
2 - Mechanics	Corporals
2 - Skilled Laborers	Pts 1st. Class
2 - Blacksmiths	Corporals
2 - Skilled Laborers	Pts. 1st Class

Buildings & Roads Section
1 - Captain - Engineer
1 - First Lieutenant
1 - Second "

Building

1 - Asst Superintendant	Sgt. Sr. Gr.
1 - Inspector	Sgt 1st Class
2 - Asst Inspectors	Sgts
8 Foremen	Sgts 1st Class
25 - Carpenters	Sgts
25 - Carpenters	Corporals
10 - Helpers	Privates
1 - Foreman Roofer	Sgt 1st Class
1 - Overseer	Sgt
12 - Roofers	Corporals

Sign Shop

1 - Sign Painter	Corporal
2 - Sign Painters	Pts 1st Class

Sheet Metal & Stoves

1 Foreman	Sgt 1st Class
3 - Overseers	Sgts
18 - Sheet Metal & Stove Men	Corporals.

Roads

1 Foreman	Sgt 1st Class
3 - District Foremen	Sgt
1 - Engineer, Steam Roller	Sgt
3 - Overseers	Sgts
6 Sub Foremen	Corporals
10 - Skilled Laborers	Pts 1st Class
40 - Laborers	Privates

Stables

1 Stable Sgt.	Sgt 1st Class
1 Asst " "	Sgt
24 Drivers	Pts 1st Class
12 - Helpers	Privates

Heating Section
1 - Captain - Engineer
1 - First Lieutenant

Heating

1 - Asst. Supt.	Sgt Sr. Gr
5 - Dist. "	Sgts 1st Class
2 - Inspectors	Sgts 1st Class
15 - Engineers	Sgts
50 - Asst. "	Corporals
250 - Firemen	Pts 1st Class
130 - "	Privates
4 - Masons	Sgts
4 - Helpers	Pts 1st Class

(15 central Plants)
(44 Individual ")

Insulation

1 - Foreman	Sgt. 1st. Class
2 - Overseers	Corporals
6 - Skilled Laborers	Pts 1st Class
2 - Helpers	Privates

Steam Fitters

1 - Foreman	Sgt 1st Class
6 - Steam Fitters	Sgts
10 - " "	Corporals
10 - Skilled Laborers	Pts. 1st. Class

Coal Distribution

1 - Supervisor	Sgt. 1st Class
1 - Coal Dispatcher	Sgt.

Executive & Engineering Section
1 - Second Lieutenant

Engineering

1 - Chief of Field Work	Sgt Sr Gr
3 - Engineers	Sgts 1st Class
3 - Junior Engineers	Sgts
3 - Rodmen	Corporals
3 - Draughtsmen	Sgts 1st Class

~ Clerical ~

1 - Chief Clerk	Sgt 1st Class
1 - Statistician	Sgt
5 - Stenographers	Sgt
3 - Complaint Clerks	Sgt
10 - Clerks	Corporals
2 - Telephone Orderlies	Corp'ls
2 - Orderlies	Privates

Note - For Use of All Sections.

Purchases & Contracts Section
1 - First Lieutenant
1 - Second "

1 - Chief Clerk	Sgt Sr. Gr.
1 - Asst Chief Clerk	Sgt. 1st Class
3 - Clerks	Sgts
1 - Stenographer	Sgt
3 - Clerks	Corporals.

Property & Supplies Section
1 First Lieutenant
1 Second "

Supplies

1 - Storekeeper	Sgt. Sr. Gr
1 - Asst	Sgt. 1st Class
6 -	Sgts.
1 - Stenographer	Sgt
4 - Clerks	Corporals
4 Skilled Laborers	Pts 1st Class
12 Helpers	Privates

Property

1 Chief Clerk	Sgt Sr Gr
3 - Clerks	Sgts
1 Stenographer	Sgt
2 - Clerks	Pts 1st Class

Personnel Section
1 - First Lieutenant
1 - Second "

Personnel & Exchange

1 - Acting 1st Sgt	Sgt Sr Gr
1 - Company Clerk	Sgt 1st Class
1 - Stenographer	Sgt
3 - Clerks	Corporals
1 - Chief Mess Sgt	Sgt 1st Class
4 - Mess Sgts	Sgts
1 - Chief Supply Sgt	Sgt 1st Class
1 - Supply Sgt	Sgt
2 - Clerks	Corporals
1 - Exchange Sgt	Sgt 1st Class
1 - Stenographer	Sgt
2 - Clerks	Corporals
2 - Orderlies	Privates
16 - Cooks	Cooks
16 - Kitchen Police	Privates
12 - Lav & Grounds Orderlies	Pts

Fire Protection Section
1 - First Lieutenant
1 Second "

1 - Acting 1st Sgt.	Q. M. Sgt
4 - Section Chiefs	Sgt 1st Class
4 " "	Sgts.
16 - Firemen	Pts 1st Class
32 - "	Privates

[4 - Stations]

Note: Motor Transportation To Be Furnished By Motor Transport Corps

Note - This Organization Chart Contains The Maximum Number, Considered Necessary To Operate Any Steam Heated Camp Under Any Conditions

Summary	Administrative	Light & Power Section	Water & Sewer Section	Bldg's & Roads Section	Heating Section	Executive & Engineering Sect	Purchases & Contracts Section	Property & Supplies Section	Personnel Sect	Fire Protection Section	Totals
Major Q.M.C.	1										1
Captains Q.M.C.	1	1	1	1	1						5
First Lieutenants Q.M.C.		1	1	1	1		1	1	1	1	8
Second Lieutenants Q.M.C.			1	1		1	1	1	1	1	7
Sergeants Sr. Gr.		1	1	1	1	1	1	2	1		9
Q.M. Sergeants										1	1
Sergeants 1st Class		3	7	13	10	7	1	1	4	4	50
Sergeants		28	15	39	26	12	4	11	7	4	146
Corporals		8	33	62	62	15	3	4	7		194
Privates 1st Class		15	34	36	270			6		16	377
Privates		4	51	62	132	2		12	30	32	325
Cooks									16		16
Totals	2	61	144	216	503	38	11	38	67	59	1139

of about 15 officers and 1 000 men. Unless great care is taken by the officer in charge, the details of the work, which are enormous, will prevent his proper supervision of the whole, and in selecting section chiefs careful consideration was given not only to technical training and experience but also to personality. It has been an unwritten law that, while the officer in charge would keep himself in touch with the organization and its work at all times by means of detailed monthly reports from each section, yet only such problems would be presented as could not be handled to advantage by the section chiefs.

Discipline in the military service is necessary, but thorough coöperation must also be secured, not only by the officers and men within the organization, but with all units in camp; and the problems presenting themselves furnished the officer in charge with many anxious moments. Any success that has been met was entirely due to the loyalty and unselfish support of the officers and men. The great advantage gained in use of soldier labor is that the officer in charge has absolute knowledge and control of his men at all times, permitting the handling of emergencies with great dispatch.

On the organization chart a tie will be noticed between the Light and Power Section and the Water and Sewer Section, which is necessary as the pumps are electrically driven and are operated by the Light and Power Section for the Water and Sewer Section, which, however, designates the time of operation. No difficulty or friction of any nature has developed from this slight dual responsibility.

Light and Power Section.

For convenience of operation, this section has been divided into Operating and Distribution, with a commissioned officer in charge of each.

Under the supervision of the former are the substation, the operation of the main pumping station and outfall sewage pumping station, booster fire pump station and refrigerating plant. Under the supervision of the latter are the electrical distribution feeders, secondary lines and all matters pertaining to the utilization of electricity.

The principal assistant of the officer in charge of electrical operation is a senior grade sergeant who is directly responsible for all field work of his department. This man's duties keep him continually in the field, and his task is to supervise and keep his chief informed of all activities in the various stations. Under his direction are the shift operators and helpers who stand watch in the different operating plants.

The Transformer Station is located on the northern edge of the camp near the main entrance, and from this point light and power is distributed to all parts of the cantonment.

Electric current for this camp is furnished by the New England Power Company, a hydroelectric property with steam standby, whose nearest generating station is at Vernon, Vt., sixty miles from Ayer. The nearest point on the transmission line was at Leominster, Mass., 8.4 miles distant, and it was necessary to build a branch line from that station. This branch consists of two separate wooden pole lines on private right-of-way. Each line transmits at 66 000 volts, 3-phase, and is composed of 3 No. 2 stranded copper conductors. There are 243 poles for each line, using steel wishbone-arms and 4-disk insulators except at corners, railroad crossings and dead-ends, where two-pole structure with steel angle-arms and 5-disk insulators are employed. A private telephone line is strung on one of the lines, giving direct communication with the various substations, generating stations and load dispatcher's office of the power system. Each transmission line terminates in the substation yard at a two-pole structure.

All high-tension equipment is of outdoor type except the transformers, which are housed in an asbestos-covered corrugated-metal building, 13 ft. by 26 ft. The high-tension apparatus consists of two K-26, 70 000-volt, triple-pole, single-throw, automatic-trip oil switches provided with bushing-type current transformers; one set of 70 000-volt electrolytic lightning arresters, outdoor 66 000-bolt metering outfit containing current and potential transformers, watt-hour meter and a graphic demand meter. A set of 5-disk suspension-type disconnecting switches is provided on each side of each oil switch and also on the line to the lightning arrester. The two transmission lines are paralleled through a high-tension bus from which a single line leads into the transformer house, first going through the metering outfit. The bank of transformers consists of three oil-insulated, water-cooled, single-phase, 66 000–2 200-volt, 500-k. v. a. transformers. Two 5 per cent. taps are provided on the high side, and the transformers will carry 750 k. v. a. each for two houses with 55 degrees rise. Cooling water is obtained from the camp supply. Each transformer is connected through a 2-in. pipe line to an oil storage tank outside of the building to permit draining of the oil, which may be pumped back through a filter.

From the 2 200-volt delta, three 300 000-C. M. slow-burning cables extend into the substation, which is about 15 ft. from the transformer house. The substation is a brick building 22 ft. by 30 ft. and contains the low-tension switchboard. The switchboard consists of ten black slate feeder panels and one bus panel. Each feeder panel is equipped with an indicating ammeter, selective ammeter switch, two 100-amp. current transformers and a manually operated triple-pole, single-throw, 300-amp., 4 500-volt oil switch provided with two time-limit automatic overload trip coils. The bus switch panel is provided with indicating ammeter, voltmeter and wattmeter, ground detector and an 800-amp. oil switch; 3-in. by $\frac{1}{8}$-in. copper busses extend the full length of the board, with taps to each feeder switch. Induction-type, overload, time-limit relays and reverse-power relays connected to the bushing transformers in the 66 000-volt oil switches are also mounted on the board. The high-tension switches are automatically tripped by a 12-volt storage battery and are closed by hand.

Each feeder is run through conduit from the board to choke coils and disconnect switches mounted on the wall, 3-conductor, No. 1, B. & S. gage, lead-covered cable being used. From the choke coils the lines pass through entrance bushings to the 6-pole structure outside, from which the circuits extend to all parts of the camp. Each circuit is protected by Type C-R lightning arresters.

The station is operated by a force of three enlisted men with grade of sergeant, working on eight-hour shifts. These men all had similar experience on high-tension stations before entering the service. The yard is surrounded by a high board fence, guarded at all times and well lighted at night.

The average monthly kw. hr., used during the fourteen months ending October 31, 1918, was 343 000, with a maximum of 446 000 for October, 1918, and minimum of 267 000 for July, 1918. The monthly power load varies between 120,000 and 160,000 kw. hr., the remainder being lighting load. Two typical daily load curves are shown for winter and summer months, each curve being the average daily load taken for one week. Figs. 1 and 2.

Main Pumping Station.

The main pumping station is located about 2½ miles from the substation.

A two-stage, 8-in. volute pump, 2 000 000 gals. per day, 250-ft. head, direct connected to a 440-volt ,3-phase ,150-h.p., 1 800 rev. per min., squirrel-cage induction motor.

A four-stage, 10-in. turbine pump, 2 000 000 gals. per day, 250-ft. head, belt driven by a 550-volt, 3-phase, 250-h.p., 600 rev. per min., phase-wound induction motor.

A two-stage, 8-in. volute pump, 2 000 000 gals. per day, 250-ft. head, direct connected to a 2 200-volt, 3-phase, 150-h.p., 1 800 rev. per min., squirrel-cage induction motor. A bank of 3 100-k. v. a. transformers step down the voltage from 2 220 to 440 and 550 volts.

Other equipment consists of one switchboard panel, two oil switches, watt-hour meter and the necessary starting compensators. All water pumped is measured by a 3 000 000 gals. per day Venturi meter provided with indicating, integrating and graphic dials.

The operating force consists of three sergeants and three first-class privates, working on eight-hour shifts.

Sewage Station.

The sewage pumping station contains one pumping unit which pumps all the camp sewage to the filter beds. This unit consists of a 10-in., single-stage centrifugal pump, 2 800 gals. per min., 655 rev. per min., 80-ft. head, belt driven by a 2 200-volt, 100-h.p., 3-phase, 1 200 rev. per min., squirrel-cage induction

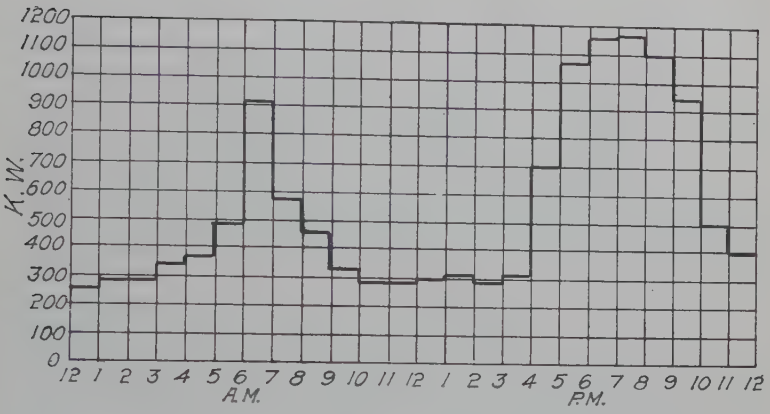


FIG. 1. TYPICAL DAILY LOAD CURVE.

Week January 15–21, 1918, average daily kw. hours, 13 100; maximum daily kw. hours, 14 400; maximum hour 1 500 kw. January 17, 7–8 P.M. Load factor for week, 42.0 per cent.

Month of January, 1918, total kw. hours, 410 900; average daily kw. hours, 13 250; maximum daily kw. hours, 14 400, January 17; minimum daily kw. hours, 11 400, January 26; maximum hour, 1 500, January 13, 14 and 17.

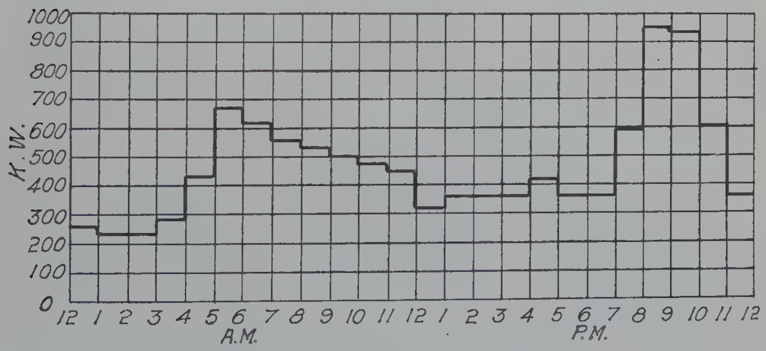


FIG. 2. TYPICAL DAILY LOAD CURVE.

Week, August 16–22, 1918, average daily kw. hours, 11 157; maximum daily kw. hours, 12 200; maximum hour, 1 200. Load factor for week, 47.1 per cent.

Month of August, 1918, total kw. hours, 357 700; average daily kw. hours, 11 530; maximum daily kw. hours, 14 400; minimum daily kw. hours, 8 700; maximum hour, 1 300.

motor. Sewage flows by gravity into a concrete well, 61.5 ft. diam., 8.16 ft. deep, located at the pumping station, from which reservoir it is pumped to the filter beds. The pump is self-priming when the well is full and the average pumpage per day is about 1 200 000 gals., requiring actual operation of about seven or eight hours. The time the pump is running is divided into three or four periods during the day, depending upon the rate of flow. Three sergeants comprise the operating force.

Booster Station.

This station is located at the water tanks on the highest elevation in camp, and the pump here is used to increase the pressure in the mains in case of serious fires. The pump suction and discharge lines are shunted from the main and controlled by gate valves. This pump is a 10-in. volute centrifugal, 2 000 gals. per min., 60-ft. head, direct connected to a 2 220-volt, 50-h.p., 3-phase, 60-cycle, 900 rev. per min., squirrel-cage motor.

Three sergeants, operators, are in charge. Each hour the height of water in the tanks is telephoned to the main pumping station and the rate of pumping regulated accordingly.

Refrigerating Plant.

The camp refrigerating plant is a building 64 ft. by 101 ft., containing a compressor and freezing room, ice-storage room, butter and egg cooler, provision cooler, beef cooler and office. The total cooling room volume is 48 000 cu. ft., and the rooms are cooled by brine circulation.

The operating-room equipment consists of two horizontal, single-cylinder, double-acting, $9\frac{1}{2}$-in. by 18-in. compressors, each belt driven by a 2 200-volt, 3-phase, 50-h.p., phase-wound induction motor; one 150 gals. per min. circulating water pump, two circulating brine pumps and brine agitator, each driven by a 220-volt, 3-phase motor.

Freezing tanks of 160 cans each capacity are installed. The blocks of ice are 300 lbs. each. Each tank is provided with a traveling crane and one ice dump. An individual boiler plant furnishes heat for the compressor room and warm water for the ice dumps. The ammonia condenser is mounted on the roof, and cooling water circulated through a cooling tower located beside the plant. During the hottest weather of the past summer 25 tons of ice were made daily in addition to a refrigerating duty of ten tons.

The total operating force consists of 1 chief operator (sergeant first class), 3 operators (sergeants), 1 mechanic (sergeant) and ten helpers (privates) working eight-hour shifts.

During a year of operation, no difficulties of any nature have been encountered in the various units, and only one interruption in service on the transmission lines, which caused no damage.

Distribution.

Under the officer in charge of distribution are two first-class sergeant foremen, one in charge of line work and the other in charge of interior wiring. The line foreman has, under his supervision, linemen, groundmen and chauffeurs, and the inside foreman has inspectors, electricians, chauffeurs and helpers.

The electrical distribution system is entirely carried on wooden pole lines with poles varying from 25 ft. to 45 ft. in height. From the substation eight 3-phase, 2 200-volt, 60-cycle feeders enter camp by two different routes, each of which carries four circuits. A ninth circuit of similar characteristics to the above runs from the substation to the remount depot, some three miles from the camp proper.

In line construction work, N. E. L. A. specifications have been adhered to throughout. Joint construction with the New England Telephone and Telegraph Company has been the practice on government-owned poles although the telephone company installs, operates and maintains its own plant.

In the distribution system there are approximately 1 625 Class B, N. E. L. A. specification, chestnut poles, which constitute approximately 38 miles of pole line. There are 171 miles of primary and secondary wiring; a series street lighting system of 315 lights fed in four separate circuits from General Electric Company, Type R. O., pole type, constant current transformers. These street-light circuits are 6.6. amps. and the lamps are 100 candle-power Mazda C. There are 173 distribution transformers on the system, varying in size from 1 k. v. a. to 100 k. v. a., the total capacity of transformers connected being 2 340 k. v. a.

Practically all transformers are protected by Westinghouse Type C-R lightning arresters. That this protection has been very effective is proven by the fact that, in spite of many severe electrical storms in this vicinity during the summer just passed, but two transformers were damaged by lightning, and both of these were transformers which were not protected by arresters within five sections of the transformer.

The main feeder circuits enter camp by two different routes. In these circuits at intervals are installed 200-amp., 4 500-volt, 3-pole, single-throw, pole-type oil switches. These switches are used not only as sectionalizing switches but also as tie switches between different circuits on the same pole. With this switching arrangement it is not only possible to sectionalize all trouble and districts in time of fire and other emergencies, but also to feed each circuit temporarily from one or more circuits in time of need.

The typical secondary distribution system for four barracks consists of 2-20 k. v. a. transformers with secondaries banked and connected on the secondary side for 110-220 volts. All services for connected lights of 1 200 watts or less are 2-wire 110 volts, and for over 1 200 watts, 3-wire 110-220 volts.

Of the interior wiring, there are approximately 38 000 outlets in camp, the majority of which are filled with 40-watt, Mazda B lamps. There are 304 miles of interior wiring which is practically all knob and tube work.

The problems which confronted the electric distribution department at its inception were many, and considerable difficulty was experienced in obtaining suitable linemen. Later, when the camp was fully inhabited and the different organizations started improving their parade grounds, a great many light and power poles were dug out of the ground. Replacing these occupied a considerable part of the early activities of the department.

It has been the practice to have a trouble man on duty each evening until 10 P.M., to investigate, and whenever possible remedy, all line troubles. Where the job demanded increased help, the rest of the line crew was turned out.

During the winter of 1917-18, which was extremely severe, the electrical department constructed a pipe-thawing outfit which rendered impressive service in freeing frozen water services and pipes. With but one exception all frozen pipes were relieved by this apparatus the same day as reported, which fact was the cause of much favorable comment when compared with the numerous stoppages which were reported by surrounding New England towns and cities.

This thawing outfit consisted of 4-10 k. v. a. transformers mounted on a wagon bed. These were connected in sets of two on the primary side with the primary winding of each pair in series, making the impressed voltage on each winding 1 100 volts. Secondaries were connected with all coils in multiple and all banked into the low voltage bus of the apparatus. The time required to free pipe lines with this outfit varied from three to twenty-two minutes, depending on the size of the pipe and length of run.

In the utilization of electricity the problems to be dealt with were almost diametrically opposed to those usually met with in the operation of public service companies. In the average utility, the electric company is continually striving to build up the load. Here, the effort has been to keep the load down. Each barracks, storehouse, etc., had installed in it a prescribed number of lights which had been determined upon as adequate for the necessary illumination of the buildings. When the barracks were occupied by the various organizations, many changes were attempted, and as the wiring in the buildings is practically all exposed, it was but a short time before a great number of unauthorized lights began to make their appearance, usually being put up in an unworkmanlike and hazardous manner with telephone wire and annunciator wire, etc., and on this account, as well as because of the fact that these added lights threatened a serious overload on the system, it very quickly became apparent that an effective means of control was necessary. As a corrective, instructions were given by the commanding general that no extensions or appliances should be allowed without a permit from the officer in charge of utilities. Frequent inspections are made of all buildings, which has to a great extent permitted control of the situation.

The normal average per capita kw. hr. consumption for the camp for all purposes, including lighting, water supply, sewage disposal, refrigeration and many smaller and miscellaneous power installations, has been 8.7 kw. hr. per month, or 105 kw. hr. per annum.

The general installation was good, but it has been found necessary to make many changes and additions to house and storehouse systems, which however is not surprising when consideration is given to the short time available in planning the camp. Too much emphasis cannot be given to the necessity for frequent and rigid inspections of all inside wiring.

Heating Section.

The heating section is headed by a commissioned officer and a commissioned assistant. For convenience in this section, the camp has been divided into districts, known as the Base Hospital, the Infantry and the Artillery.

The Base Hospital is supplied by a plant of 12 H. R. T. boilers rated at 150 h.p. each, and an auxiliary plant is under construction, having 4 H. R. T. boilers rated at 150 h.p. each.

The Infantry Section is supplied from 10 central heating plants, each of which contains 10 cast-iron sectional boilers, 30 of which are rated at 9 375 square feet and 70 of which are rated at 9 175 sq. ft.

The Artillery Section is supplied from 3 plants, each having 7 cast-iron sectional boilers rated at 9 000 sq. ft.

Some comment has been occasioned by the use of cast-iron sectional boilers, but it is understood that a shortage of tubular boilers existed when the type was designated. In operating, however, no serious obstacle has been met, and all the plants, both tubular and cast-iron, have given uniform satisfaction, although the haste with which they were installed made corrections necessary, which will be mentioned later, but on which no criticism is justified. It should be understood that steam heat for the buildings was not seriously considered until the construction of the camp was well along.

Steam is distributed from the boiler houses to the various buildings served, through mains carried overhead on poles and insulated by seaweed quilting (two thicknesses), all wrapped in 2-ply rubberoid paper which is fastened with large-sized marlin. Originally no return systems were provided for any of the central heating plants, but after four months of operation estimates were prepared for all plants individually, which indicated that the net earnings on the investment, after all fixed charges were considered, proved to average 6.1 per cent. for the Infantry and Artillery sections and 13.5 per cent. for the Base Hospital; the latter was very promptly authorized and is now in operation.

The individual heating plants all have cast-iron boilers ranging from 3 to 150 h.p. in capacity, with the exception of the laundry plant now under construction, which is to have two 150-h.p. H. R. T. boilers. Of the individual plants, two are equipped with four boilers.

The following figures will give some idea of the service provided in this section:

a. Number of buildings heated by steam, 718.

b. Number of latrines furnished with hot water, 264.

c. Cubical contents of buildings heated by steam, 30 854 290 cu. ft.

d. Square feet of floor area in buildings heated by steam, 3 080 329 sq. ft.

e. Number of miles of steam piping in camp, 80 miles.

f. Square feet of radiation in radiators or pipe coils, 808 540 sq. ft.

g. Number of radiator sections equivalent to 808 540 sq. ft., 161 708.

h. Square feet of covered piping exposed to outside temperatures, 55 442 sq. ft.

i. Number of traps in service, 2 000.

j. Number of boilers, 183.

k. Total horse-power, 11 627 h. p.

l. Maximum daily coal consumption, 445 tons.

m. Maximum daily evaporation, 800 000 gals.

n. Daily use of hot water at 100 degrees temperature in latrines, 43 800 gals.

From the above general figures it is interesting to give a few figures per unit:

a. With an average temperature for the month of February, 1918, of 21 degrees, the coal burned per man, per day, is 23.7 lbs. Based on full capacity of the camp, the figure becomes 16.9 lbs.

b. Based on February, the coal burned per day, per sq. ft. of floor area, is 0.0206 lb.

c. Also based on February, the coal burned per day, per cubic foot of building, is 0.0206 lb.

d. The water evaporated per man, per day, for the month of February is 21.3 gals. Based on camp at full capacity, this figure becomes 15.2 gals.

e. Hot water at 100 degrees used per man, per day, is 1.25 gals.

The Heating Section is divided into two departments, — operating and maintenance. The former is divided into four districts with a sergeant first class in each acting as district superintendent. All plants are operated by three shifts of eight hours each, and each central heating plant is in charge of a sergeant, acting as engineer, each shift having a corporal in charge.

In general, it has been considered that one fireman, all of whom are privates first class, can serve two boilers. No storage space is available in the houses, nor are bins provided outside, which increases the coal passers and ash wheelers considerably beyond the number ordinarily required in usual civilian practice. It has been the experience at this camp that four are needed in each watch.

The individual plants, 44 in number, are scattered, and it has been found necessary to use fifty men on this work, which is in charge of a sergeant first class, acting as superintendent of individual plants, assisted by three sergeants. Considerable difficulty has been experienced in successful operation of the very small plants, which require constant attention.

Shortly after the plants were installed, test was made in one of the infantry boiler houses, which showed that the evaporation was 5.5 lbs. water evaporated per pound of fuel placed in the fire boxes. The flue gas temperatures were above 800 degrees Fahr. At this time conditions were unfavorable, the firemen were still experimenting with drafts, cleaning fires and generally becoming familiar with their duties. Gradual corrections were made to raise the efficiency of all the plants, draft conditions were studied, thickness of the fire varied to meet the draft available at the different plants. The fires ranged in thickness from 8 to 12 ins. Fires had been cleaned too frequently, and the period was gradually increased until it became once in two days. Shaking down fires became more frequent until twice in a watch proved more satisfactory. Becoming familiar with the type of boilers and the best draft and fire conditions raised the evaporation from the test figure of 5.5 lbs. to 6.8 lbs., or a coal saving of 23.8 per cent. As a further economical measure and to reduce the flue gas temperatures, the grate surfaces were cut down one third. It was found that in order to run this type of boiler at capacity or slightly above, there was not enough combustion space for the grate area, thus causing combustion to take place in the larger area provided for the flues. This reduction in the grate area raised the evaporation to 7.5 lbs., thus reducing the coal 12.7 per cent. more, giving 68.5 per cent. boiler efficiency and a total saving in coal from the first test of 36.5 per cent. The evaporation for the 13 central heating plants, using cast-iron sectional boilers and containing a total of 121 boilers, reads as follows:

February	7.5 lbs.
March	7.48 lbs.
April	7.48 lbs.

NOTE.—7.5 lbs. evaporation is equivalent to 69.5% boiler efficiency.

At the Base Hospital, two boilers were not installed until early this spring (1918) and during the severe weather the plant operated with 10 H. R. T. boilers, rated at 150 h.p. each, with a 25 per cent. over-load during the months of January and February. Anthracite coal had been furnished as fuel, bituminous not being available. This was the last plant to be constructed and was built under extremely unfavorable conditions, — fire boxes and brick work being put up and soaked with rain before the building was roofed. Arch and cheek plates were burned, dead plates cracked, and the back arches, which were of T-iron unprotected by fire brick, fell in from the hot gases from the combustion chamber. Fortunately this condition did not become serious until after the severe weather had passed, all of which has been corrected and replaced with first-class material and workmanship. By introduction of bituminous coal at this plant, there was a saving of 15 per cent. in the consumption and 27 per cent. in the cost of producing steam. Anthracite coal of

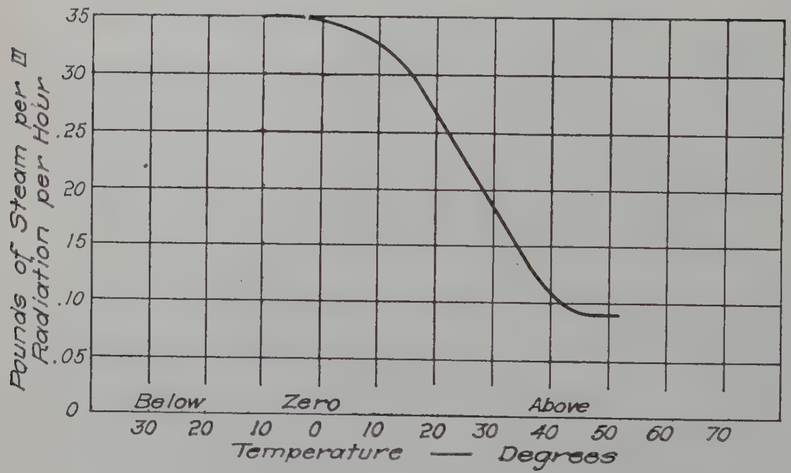


FIG. 3. POUNDS OF STEAM PER SQ. FT. OF RADIATION PER HOUR.
Plot, 17 weeks, 3 days. Boiler houses, 2–14.

good quality was used in the cast-iron sectional boilers with entire satisfaction. Water evaporation of all the central heating plants for the first four months of 1918 reads as follows:

WATER EVAPORATION.

Month.	Daily Average Evaporation. Gallons.	Average Temperature.
January	676 000	13 degrees above
February	491 500	21 degrees above
March	343 000	35 degrees above
April	242 500	47 degrees above

Twenty-four-hour max., 728 900.

COAL CONSUMPTION.

Month.	Month Tons.	Daily Ave.	Estimated.	Percentage under Estimate.
January	12 486	403	533	19.3
February	8 217	293	461	36.4
March	6 099	197	318	28.1
April	4 053	135	248	45.5

Twenty-four-hour max., 414.

Grate surfaces were not all cut down until the middle of February, although the work was started in December, some difficulty being experienced in securing the necessary material, and also lack of men caused some hindrance. During January the average temperature was 13 degrees, and the minimum 35 degrees, below zero; average temperature for one week was 2 degrees below zero, in spite of which the coal consumed was 19 per cent. under the estimate.

During construction, which was rushed with all possible speed, difficulty was encountered in securing labor familiar with setting cast-iron boilers, with the result that a few sections and many nipples between sections were cracked, causing an average of one boiler in each plant to be out of service entirely and others to leak more or less. With one boiler out of service, the capacity of the plants was cut down 10 per cent., and when zero temperature existed the boilers in service were operating at rating, but no over-loads were possible. The following table shows the relation between radiation and capacity of the plants, No. 1 being the Base Hospital:

B. H. No.	Radiation. Sq. Ft.	Boiler Rating 0° Temperature.	Radiation in Per Cent. of Boiler Rating at 0° Temp.	Radiation in Per Cent. of Boiler Rating at 0° Temp. with 1 B. down.	B. H. P.
1	154 754	124 800	124.0	153.0	1 500
2	53 570	58 350	91.6	101.8	665
3	51 223	59 600	86.0	95.5	678
4	53 762	59 600	90.2	100.0	678
5	47 259	58 350	81.1	90.0	665
6	49 633	58 350	84.7	94.2	665
7	51 870	58 350	89.0	99.0	665
8	49 424	58 350	84.8	94.2	665
9	53 721	58 350	92.0	102.0	665
10	50 060	58 350	85.8	95.5	665
11	50 045	59 600	83.8	93.2	678
12	34 513	41 600	82.9	97.0	475
13	32 901	41 600	80.7	94.2	475
14	32 241	39 100	85.0	99.3	457
Totals	765 776	834 350			9 596

In the curve plotted (Fig. 3) to show the variation in pounds of steam per square foot of radiation, outside lines and inside covered mains are included, with due allowances for outside temperature, inside temperature and the efficiency of the covering, besides the equivalent direct heating surfaces in the coils in the hot-water tanks.

Permanent bridge walls have been placed in the boilers to cut down the grate area and covering replaced where boilers were torn down. All outside distribution mains were placed in first-class order and have been painted. All stacks have been painted. The total cost of repairs to the boiler plants was 1.6 per cent. of the first cost. There are 2 000 traps which require continual care, and if not inspected at least twice daily will clog, freeze, or both, due to the installation of radiators in series, so that when the loading valve is shut circulation ceases. In spite of the care and attention necessary, no change in the system is recommended. Trouble has been experienced from men in the barracks opening and closing valves, including the main throttle valves in the buildings, which was overcome to a considerable extent, however, by sealing the throttle valves. During the summer one boiler in each plant is operated for hot water at about 66 per cent. of rating. At the Base Hospital one boiler carried cooking, sterilizing, hot water, laundry, etc., at 60 per cent. of rating. Twenty-four-hour service has been provided with a heating system which was original in many ways, but which on the whole has proved satisfactory.

Maintenance.

The Maintenance Department does all steam repair work, insulation and mason work, which is in charge of a sergeant first class. The operating and maintenance forces work in harmony, and small jobs, such as cleaning traps, are done by the men from each boiler house who are out on distribution mains and in the barracks inspecting traps.

The question has been asked many times as to the value of the central heating plant system over the individual plants for each barracks, or the use of room heaters. Experience here indicates central heating plants preferable from every viewpoint.

BUILDINGS AND ROADS.

Buildings.

This section is in charge of a commissioned officer, who, however, should have two commissioned assistants; one for buildings and one for roads. The Building Department has a sergeant first class acting as superintendent, 6 carpenter foremen (sergeants), 24 carpenters (privates), a sheet-metal and stove-repair shop with a foreman (sergeant first class) in charge, and 12 privates.

The problems in this section are practically all of maintenance, very little new construction being attempted. The buildings, as indicated heretofore, are of only semi-permanent type, the entire camp having been designed for a service of from five to ten years. While the buildings will safely carry the load distributed as planned, unwise congestion, until corrected, caused some apprehension. For instance, the first-floor squad room, intended for dormitory purposes, was frequently converted into a recreation room, with piano, billiard tables, etc., causing an over-load on the second floor, and a concentrated load on the first. In some instances, supporting columns were removed. Continual and rigid inspection of all buildings is necessary. The amount of repairs necessary is naturally high, the roofs perhaps requiring the most attention.

It has been found that the green square-edge roofing boards have curled in seasoning and pushed through the two-ply rubberoid paper; and in future construction it is believed that matched boards should be used, placed vertically, and roofing paper strips laid vertically instead of horizontally. The increased cost should not be excessive. Heavy snowfalls were experienced last winter, and, in spite of all attempts at control, men with hob-nailed shoes, using iron shovels, were allowed on the roof to remove the snow, causing many leaks; one building having over one hundred in one week. An increased pitch to the roof, it is believed, would to a great extent overcome this condition. Buildings have sagged to some extent, but are promptly jacked up. The life of stair treads, which are of $1\frac{1}{8}$-in. hard pine, is about four months when the barrack is continuously occupied.

About 600 stoves and ranges of numerous makes are in camp, the repair of which requires a considerable force and much material. The camp has accommodations for approximately a population of 37 000, which a great portion of the time has been exceeded, reaching as high as 47 000. During the summer several thousand were housed under canvas, but as the majority so provided for were attached to barracks for mess, the additional use of the cooking ranges was noticeable in the unusual amount of repairs necessary. The galvanized iron stacks and sheet metal in the lavatories need constant repair. The number of repair jobs increases each month, with increasing attention necessary.

From January 1 to November 1, 1918, 10 255 repair jobs were completed, requiring 94 267 hours' labor, the following material being used:

Lumber	100 000 B.M.
Nails	154 kegs
Sheet metal	13 994 lbs.
Roofing paper	11 772 sq. ft.
Roofing compound	36 920 lbs.

Roads.

The road department has one sergeant first class, acting as superintendent, 3 district inspectors (sergeants), 6 foremen (sergeants) and 40 laborers (privates). The labor is increased during the summer by using the men from the heating plants.

The roads consist of three general types, — tar macadam, about 8 miles; gravel, 13 miles; and a small amount of concrete. The tar macadam is further separated into two sub-types, according to the kind of base used. In 1917 the base specified was a 6-in. layer of field stone laid similarly to a Telford foundation and bound by rolling in gravel. The source of material was the large number of stone walls then existing in the camp. In 1918 a 4-in. waterbound base was substituted for the field stone in the specifications, as the source of the latter had been entirely depleted. This base consisted of 6 ins. of egg-size stone rolled to 4 ins. and bound with dust. Upon these bases was laid the wearing surface of egg stone. This layer is 2 ins. thick when lightly rolled and penetrated with 1½ gals. of Tarvia "X" per square yard. Pea stone is swept into the pores and the seal coat of ½ gal. of Tarvia "X" per square yard is applied. This material is thrown on top, and, after rolling, the road is ready for traffic.

Only a small amount of concrete road has been built, such as entrances to fire stations, strips along loading platforms at the storehouses, etc. Gravel roads for the company streets, serving the kitchen ends, have proved satisfactory, but are not recommended for other locations. Traffic is heavy, making necessary continual patching and building up of the shoulders. During the winter, roads are kept clean by using snowplows attached to three-ton motor trucks and animal-drawn plows.

From January 1 to November 1, 1918, 2 880 repair jobs were completed, requiring 125 778 hours' labor and using the following material:

Cement	3 431 bags
Tarvia "B"	10 715 gals.
Tarvia "X"	4 500 gals.
Tarvia "A"	4 500 gals.

WATER AND SEWER SECTION.

This section is subdivided into three departments, — *Water, Sewer and Plumbing*, in general charge of which is a commissioned officer with a commissioned assistant. In the *Water Division* are 2 inspectors (sergeants first class), 3 foremen (sergeants), 4 gang foremen (corporals), 34 laborers (privates). *Sewer Division*: 1 inspector (sergeant first class), 2 foremen (sergeants), 4 gang foremen (corporals), 25 laborers (privates). *Plumbing Division*: 2 inspectors (sergeants first class), 8 foremen (sergeants), 13 plumbers (corporals), 13 helpers (privates).

Water.

The source of supply is located near a pond about two miles from center of camp, originally consisting of one dug well 50 ft. in diameter, about 28 ft. deep, sunk in fine sand and having a capacity of approximately 2 000 000 gals. a day. Late in the fall of 1917 this supply proved inadequate, and an area of about one acre, located on a rise some 300 ft. from the well, was stripped of soil and used as an auxiliary filter for temporary relief of shortage. The water to supply this filter was pumped from the pond and percolated back to the well, increasing the supply approximately about 200 000 gals. a day. Unfortunately extremely severe weather was experienced early in the winter, the temperature dropping as low as 35 degrees below zero; and in spite of the fact that the discharge pump was operated continually the suction and distributing lines froze solidly. By the time this difficulty was overcome, the pond had frozen solid to a considerable distance beyond the suction, preventing the use of the auxiliary supply, which caused a very acute shortage of water during the entire winter. In the spring of 1918, forty $2\frac{1}{2}$-in. tubular wells were driven along the shore of the pond, which yield approximately 1 000 000 gals. per day and are brought to the main dug well by siphonic action. Since this installation, ample supply has been available at all times.

The quality of the water is excellent both in appearance and chemically. Result of analysis made by the Massachusetts State Department of Health follows:

TAP AT PUMPING STATION.
Parts per 100 000

Turbidity, sediment, color	None
Odor, cold and hot	None
Residue on evaporation	7.00
Free ammonia	0.0012
Album. ammonia	.0032
Chlorine	.84
Nitrates	.0060
Nitrites	.0000
Hardness	3.3
Iron	.005

MAIN COLLECTING WELL ABOUT 8 INS. FROM SURFACE.
Parts per 100 000

Turbidity, sediment, color	None
Odor, cold	None
Odor, hot	Very faintly, bleach
Residue on evaporation	7.40
Free ammonia	.0006
Album. ammonia	.0034
Chlorine	1.30
Nitrates	.0000
Nitrites	.0000
Hardness	3.5
Iron	.015

A full description of all pumping units has been furnished under Light and Power Section.

Four storage tanks were originally constructed, 30 ft.

in diameter, 20 ft. in depth, combined capacity 400 000 gals., and are located adjacent to the booster pump, the highest area of the camp, on wooden trestles 26 ft. above the ground. The elevation of the bottom of the tanks is 407.33.

The distribution system consists of the following pipe:

12-inch	12 850 ft.
10-inch	7 820 ft.
8-inch	77 280 ft.
6-inch	16 000 ft.
4-inch	2 010 ft.
Service connections about	97 000 ft.
Total	212 960 ft.

There are two 12-in. mains leading into camp from pumping station. A double loop of 8-in. pipe parallels the two roads which encircle camp, one being, roughly, 150 ft. inside the outer road and the other being 30 ft. outside the inner road. These loops are brought together in two 10-in. lines to the tanks. Two 10-in. lines run from tanks to Hospital district, where another 8-in. loop encircles this group of buildings, which is intersected with 6-in. cross connections. The remount station, which is located about two miles from the center of the camp, is supplied through an 8-in. wood pipe line which crosses the central portion of camp, tying in the several loops connecting at the main from the village of Ayer at West Main Street and following the Nashua Valley to the remount station. The Ayer connection is gated and provided with meter. A 300 000-gals. supply could be obtained from Ayer in case of necessity. All pipe was originally laid a uniform depth of 5 ft. below the surface of the ground. However, much grading has been carried on by various units, necessitating the lowering of considerable pipe.

The camp is provided with 253 4-in. hydrants with independent gates opening to the left. The system has 140 gate valves, all of which open to the left, excepting 3 at main pumping station. All services are of galvanized iron, ranging from $\frac{3}{4}$ in. to 2 ins. in diameter. Each service is provided with a corporation cock at the main and a stop and waste valve about 5 ft. from building line to which service runs.

During the early spring, samples of water, which are taken daily, were found to contain a comparatively high amount of bacteria, produced by surface water entering the well, which defect was overcome. A temporary apparatus was built, introducing a solution of hypo into the well, but by fall, chlorinator apparatus with automatic control was installed, chlorine being introduced into section of pumps at the rate of .24 p.m.m., which was found sufficient to sterilize the water but leave no taste of chlorine. It has not been found necessary to operate the chlorinator continuously.

Practically all mains in the camp are of machine-banded Remco wood stave pipe, which has some advantages over iron pipe, in that it can be laid more rapidly, is easily transported and is quickly and easily repaired. Cocks were tapped into the mains, covered with a wooden box, but some difficulty has been experienced by trucks driving over the boxes, forcing cock out of the main, producing an irregular hole. Special brass plugs were cast in all corporation cock sizes, and when a cock was burst in the pipe the hole was reamed out in a true circle and the larger size plug inserted. A new tap was then made, a corporation cock inserted and a swing joint installed to relieve the rigidity of the service line. The wood pipe has proved itself unusually free from leakage. Only one serious break has occurred, which took place last winter on the main to the remount station, but from which no great inconvenience resulted. It was found that a sand scour had cut the wire, spreading the staves, the velocity of the water cutting a hole vertically in the pipe about 4 ins. in length and ½ in. wide. In making repairs on wood stave pipe, the defective section is removed, a special casting 21 ins. long with standard A. W. W. bell on one end and a bell of larger diameter on other end to receive wood stave pipe, is calked on wood pipe, a filler piece of cast-iron pipe is inserted where section of wood was removed, a sleeve placed of cast-iron pipe, and another special casting 21 ins. with large bell for wood stave on one end, and A. W. W. spigot on the other end, is placed at opposite end of break; joints are then calked and the line put in service.

Consumption. — The water consumption for the year beginning November 1, 1917, and ending October 31, 1918, has averaged 52 gals. per capita, which is slightly less than the original estimate before construction of 55 gals. per capita. It should be noted, however, that the estimate did not contemplate the use of steam for heating purposes. In attempting an estimate of water consumption for training camps, it is believed that it would be well to consider the per capita consumption for ordinary purposes, such as bathing, cooking, street sprinkling, etc., separately from that to be consumed in special uses, such as steam heating, refrigerating, etc. From various tests, it is estimated that the leakage is approximately 100,000 gals. per day, which will hardly be considered excessive. It has been the aim of the organization to prevent waste of water as much as possible, various devices being used, one of which produced notable results. A lead plug ½ in. long, tapered ⅝ in. to ¾ in. diameter and tapped with ⅛ in. diameter hole, was inserted in the service pipe just back of each bibb or valve, and which reduced the consumption approximately 5 gals. per capita. Leaking of shower head valves was corrected by grinding into the core about ¼ in., tapping for a No. 17 brass screw and inserting a ½-in. composition seat washer which resulted in a further saving of approximately 2 gals. per capita. Continuous inspection of all lavatories has been necessary, various instructions have been given relative to use of water, placards being used freely, and frequent replacement of washers.

Bathing by units at different hours was considered, but it is not considered necessary; the best results being obtained from corrections of defects and the coöperation of all in economical use of water. During the first four months of operations, the per capita consumption was high, but decreased rapidly as the population became accustomed to the economical use of water and again became high in July, 1918, when the new division was formed. It is noticeable, however, that the consumption was soon reduced to a fair rate. It will be noticed by the following figures that the daily average is considerably increased during the months when the heating plants are in operation.

WATER CONSUMPTION.

	Ave. Consumption. Gals. per Day.	Ave. Population.	Ave. Gals. per Cap. per Day.
November, 1917	1 672 000	31 560	52.9
December	1 994 000	30 242	65.9
January, 1918	1 814 813	32 206	56.3
February	1 649 400	25 278	65.1
March	1 643 000	30 049	54.9
April	1 648 300	34 540	47.7
May	1 727 000	39 625	43.6
June	1 787 500	44 141	39.3
July	1 612 000	30 749	54.5
August	1 990 000	41 073	47.6
September	2 045 000	47 440	43.1
October	2 124 200	45 710	46.6
Total	21 707 213	432 613	623.8
Average	1 808 933	36 051	51.5
Maximum	(Oct.) 2 124 200	(Sept.) 47 440	(Dec., '17) 65.9
Minimum	(July) 1 612 000	(Feb.) 25 278	(June) 39.3

Plumbing.

In addition to the ordinary maintenance of plumbing fixtures, the repair work has been found to be enormous, owing greatly to the type of buildings which retain heat for only a short period. During January and February, 1918, over 12 000 ft. of galvanized pipe was used in repairing frozen pipes. Services were frequently frozen, but it is believed this difficulty has been overcome to a great extent by boxing-in service pipes, by filling with dry sawdust and covering the outside with tar paper, great care being used in making tight joints to the kitchen floors. In thawing service pipes, electricity was used to a great extent, description of the apparatus being given in the Light and Power Section. Last winter over 2 000 freeze-up jobs were recorded, but in no case was a building without water more than twenty-four hours, the trouble usually being remedied within six hours.

Considerable difficulty has been experienced with the hot-water tanks, which have not withstood the pressure; but it has been eliminated by the use of pressure-reducing valves.

About 2 500 repair jobs per month are completed by this department, requiring about thirty thousand hours' labor.

Sewers and Sewage Disposal.

Three separate systems are in use, two serving the Base Hospital, consisting of the collecting systems and two disposal plants, each being provided with a dosing tank and intermittent filters. The third or principal system collects from the camp proper, and the remount station, all carrying sanitary sewage only, the connections being with lavatories and kitchens.

The general drainage slopes to the valley of a brook running through and near the center of the camp, to a pump well located 6 200 ft. north of the northern boundary of the camp, from which point sewage is raised about 80 ft. to intermittent filters, about 3 000 ft. beyond. The main collecting system consists of district sewers, intercepting sewers and outfall sewers. The total length of all sewers, including Base Hospital and remount station, is about 22 miles; the house connections, which are all 6-in., amount to about 8 miles.

The plants at the Base Hospital are similar, excepting in number of beds — the first having six, covering about one and one-half acres in area, and the second four, covering about one acre. Each plant has a dosing tank 12 ft. by 24 ft., constructed of concrete with flat slab roof, and capacity of 13 000 gals. An iron bar screen is set in a small chamber at the entrance. The tank contains an 8-in. siphon 6-ft. draft, discharging into a concrete chamber, which is connected to the filters by a 10-in. pipe. An 8-in. pipe pass, controlled by a shear gate, connects the screening chamber with the discharge chamber, permitting work in the tank. The beds are under-drained with 4-in. pipe, the effluent being discharged into the Nashua River.

The Hospital plant was constructed to accommodate a population of 1 000 on a basis of 50 gals. per capita, but which has been greatly exceeded, normally averaging a population of 1 800 and producing an average dose of 81 000 gals. per acre. During the epidemic of Spanish influenza this fall, the population contributing to this plant was for a short time about 5 000; while this condition was abnormal, filtration was continued, and although the beds were constantly flooded, the effluent samples remained stable for over two weeks. The following table gives analysis of raw sewage and effluent.

PARTS PER 1 000 000.

Source of Sample.	Week Ending.	Free Ammonia.	Album. Ammonia.	Chlorine.	Oxygen Consumed.	Residue on Evap.		Nitrate.
						Total.	Fixed.	
Base H.	Sept. 9	11.6	12.9	39.6	308.0	960	290	2.6
No. 1	16	15.5	14.5	68.0	316.0	1 050	274	4.4
Raw.	23	18.5	18.5	24.6	369.6	1 252	256	3.4
Sewage.	30	37.0	38.0	42.8	358.0	1 200	334	
Base H.	Oct. 7	18.0	20.0	47.8	348.0	960	214	4.00
No. 1	14	14.0	18.0	60.0	362.0	1 030	316	3.50
Raw.	21	17.0	19.0	52.0	320.0	940	222	3.20
Sewage.	28	11.0	16.0	39.6	338.0	1 024	250	4.50

Septic tanks and sludge beds are now being constructed at this plant, which will relieve the situation.

The principal system requires pumping to the beds, a description of the pumping station being found under the Light and Power Section. The pump well, where the sewage is collected, is of concrete construction, with a slab roof supported on piers, circular in form, 61 ft., 6 ins. diam. and 150 000 gals. capacity. Sewage enters through iron bar screens, which slope to the roof of the well, in which are two openings, with perforated iron covers, on which screenings are raked and drained. A 16-in. pump suction passes through the well and terminates in a rectangular sump in the center.

An agitator is installed, but so far no deposit has been noticed on the floor of the well, making its use unnecessary.

The 20 intermittent filters, of one acre each, were built by removing top soil which was used in forming embankments separating into beds. No under-drains are necessary, the sand being particularly well adapted for this use. The flow to the beds is controlled by 12-in. shear gates, distribution being effected by wooden sluices having suitable spaced openings in the converging sides. Some difficulty is being experienced with grease.

Each kitchen is provided with a grease trap, 73 of which are of concrete and which have proved fairly satisfactory; the balance, 167, are of vitrified pipe and proved useless, retaining practically no grease, and are being replaced with a wooden trap, based on capacity of two thirds per gallon per capita.

Executive and Engineering.

As soon as possible, in forming the organization, a system was installed, which has worked satisfactorily and which has permitted the compiling of statistics.

Each section has its distinct location in the general office, has 'phone service through a private switchboard, which also extends to each central heating plant, each pumping station, storehouse office, shops and personnel office. The fire stations are in the camp exchange. One desk receives all complaints, night and day service being maintained. From this desk the complaint goes to the section interested, except at night, when in event of an emergency the trouble is reported to a man on watch in the personnel office, who delivers the message to the proper foreman. Job tickets are made in triplicate, two to the foreman, who uses one in securing material from the storehouse; one is retained until the job is completed, when turned back to the office with the hours of labor and material used, which is then figured for cost and charged against the proper building or system. These costs are all compiled monthly. Each section chief requiring material makes requisition on the Purchase and Contract Section, where the material is purchased, and which when delivered is received and checked by the Property and Supply Section, after which invoices return to the Purchase and Contract Section to be vouchered and paid.

In each section complete logs are kept of the operation of stations and plants, and monthly reports are made by each section to the officer in charge, containing in detail the activities of operating and maintenance.

No attempt has been made in this paper to give details of the management or various forms used, as this to some extent depends upon the individual camp to be operated. Such records are kept as will show amount of labor and material against each building or system.

The necessity for a small engineer division was early recognized, and a force of seven engineers and three draftsmen was formed, the section being in charge of a sergeant first class, all the others having grade of sergeant. Two parties are kept in the field continuously; in fact, it has at times been necessary to increase this force. All plans are kept up to date, showing changes and additions.

Purchases and Contracts.

This section at present requires only a few experienced non-commissioned officers and clerks, whose work is supervised by the executive officer. In time, however, it can be readily seen that an officer might be required to give his entire attention to this section.

Property and Supplies.

All material and tools, after being paid for, become property of the Government, and a strict accounting must be kept. Ordinary building supplies used in maintenance work can be expended and dropped from the records when used, but all tools of every nature must be retained on the records, and can only be dropped when unserviceable by survey or other methods. The fact that a shovel is broken or worn out does not affect the case at all, it must be carried until property is dropped. The work requires the supervision of an experienced commissioned officer with a small but efficient force.

Personnel.

In operating the utilities of a camp with soldier labor, many advantages are obtained, particularly in the case of control of the organization; on the other hand, many responsibilities must be assumed which would not be necessary in civilian practice, where the responsibility ends with supervision over the working hours of the force. In the military service, everything a soldier eats, wears or uses in his work must be provided for him. Constant medical attention must be furnished; frequent inspections must be held, that the health and morale of the command be maintained at as high a degree of efficiency as possible. To do all this requires a considerable clerical and supervising force, as the method is all prescribed by regulations. A certain allowance of food is made per day, which to a great extent is drawn from the subsistence stores; clothing must be requisitioned and issued, and tools of all description secured; for all of which a strict account must be made.

Various records are kept of each enlisted man, and monthly reports must be made. The paper work of an organization is really enormous, and requires experienced men for this purpose. Soldier cooks must be provided, barracks must be kept orderly and grounds must be kept neat. Of the force of 850 men at this camp, about seventy are required on this work, including the clerical force of the personnel officer who at present assumes this duty in addition to his position of assistant engineer, Heating Department. The work, however, is important enough to require all the time of a capable officer.

An unusually capable organization has been made possible owing to skilled mechanics who were selected in the draft, but considerable doubt is held as to the possibility of securing this same class of mechanics for service during peace times.

Should the camp be maintained for a considerable time, and the enlisted men discharged, a very grave problem would arise in securing an efficient force. The pay of a sergeant is forty-four dollars per month, and although his every want is provided, yet the average mechanic could hardly be expected to view with favor the idea of enlisting for such remuneration. This situation, however, will not have to be faced for several months.

Fire Protection.

A unit designated as the 301st Fire Truck and Hose Company is under the direction of the utilities officer, and consists of a first lieutenant, officer in charge, and the following enlisted personnel:

1 Supply sergeant,	Quartermaster sergeant.
3 Station chiefs,	Sergeants first class.
3 Assistant station chiefs,	Sergeants.
12 Firemen,	Privates first class.
24 Fire Department Reserves,	Privates.

One station is located at the Base Hospital, two in the camp proper, and one at the remount station.

The apparatus consists of one American La France pumping engine, capacity 750 gals. per minute, with a 40-gal. chemical tank; two combination hose and chemical wagons, each equipped with one 40-gal. chemical tank; and three Howe-Ford combination engines.

Ordinary city practice in managing the Fire Department is followed, except that the service of the men is almost continuous, no man being permitted to be absent oftener than twenty-four hours in ten days. Inspections are carried on by designated men from each station in the area where located, to see that the buildings have the necessary number of water pails, hand pumps, chemical extinguishers, etc., and that rubbish, waste paper, etc., does not become a fire hazard. Companies are drilled each day with the apparatus and its appliances. During the winter months, to prevent freezing, calcium chloride is mixed with the water in the barrels, hand pumps and pails that are located at the storehouses, stables, etc., which are not heated. In each regimental area, an assistant fire marshal is appointed who coöperates with the officer in charge of the Fire Truck and Hose Company, and the officer in charge of utilities.

Forty hose-reel houses, each containing a reel and 500 ft. of $2\frac{1}{2}$-in. hose are distributed throughout the camp, and have not proved of any particular value.

The fire-alarm system as originally laid out consists of 36 fire boxes located at advantageous points throughout the cantonment. Each box contains a common telephone and is connected with a special signal in the central exchange of the telephone company, which serves the cantonment only. The signaling apparatus, which transmits the box numbers to the house gongs and recording tapes in the stations, was also located in the telephone office, and the chief operator transmitted all alarms of fire from the telephone boxes to the gong circuit. In addition to this signaling apparatus, there was installed a system of automatic alarms in the various quartermaster and ordnance storehouses in the camp, which transmits automatically an alarm to the various house gongs which corresponds to the storehouse in which a fire may arise. There are, at the present time, 15 storehouses protected by this automatic service.

In addition, there is being installed at the Base Hospital, at the present time, an automatic system of 54 separate stations which will afford complete protection for this very important area.

Since the original installation, it has been deemed advisable to move all apparatus connected with the camp fire-alarm system to fire headquarters, and at the present time this work is being carried out with a view of eliminating all of this apparatus from the telephone exchange building and moving the same to fire headquarters, where it rightfully belongs. When this change has been made, all alarms will be received directly at fire headquarters, where the proper transmittal to the various fire stations will take place.

In order to warn all units in the cantonment of an alarm of fire, there is installed at fire headquarters building a compressed air siren. This siren serves not only to indicate alarms of fire, but is also used for certain special calls at the convenience of the commanding general.

The fire loss has been extremely low in camp, the result being obtained by rigid inspections and strict attention being given at all times to fire prevention.

In looking back during the past year it is possible to see where many operating features have been improved and also where some conditions can be improved in the future. These, however, are of rather a minor nature. The total number of repair jobs completed during the year exceeds 65 000, all of which were made necessary by ordinary use of buildings and systems.

The work has been arduous, but at all times interesting, many problems continually arising which are not met in civil life.

Considerable of the satisfaction in operating is due to the careful engineering work during construction, which was under the direction of Mr. Frank A. Barbour, supervising engineer, whose paper presented to the Boston Society of Civil Engineers, on "Camp Devens and Its Water Supply," contains considerable data and explanation not included in this paper.

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BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

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DISCUSSION OF THE OPEN-AIR TREATMENT OF INFLUENZA.

By Charles F. Dingman,* Member Boston Society of Civil Engineers.

It was indeed refreshing to read Colonel Brooks's description of the open-air treatment given influenza patients at Camp Brooks and elsewhere in the state. It may well be that this marks the commencement of an era when common-sense methods will be applied to the cure of all such diseases.

However, none of the three articles seems to me to offer any solution of the problem of preventing a recurrence of such an epidemic, nor in fact do any of them approach the subject in a manner which, to my mind, is calculated to shed any light upon the real cause of the epidemic.

Major Harrington's paper raises the significant point that "most of the cases received at our hospital were boys between eighteen and twenty-four years, supposed to have been physically fit. They had been struck down like little children."

Some time ago I wrote a letter to the editor of the Springfield *Republican* on this very point. While the arguments advanced by me in that letter may not have been original, the fact that the letter has been extensively quoted since seems to show that it struck a sympathetic note in the minds of many others who were also thinking of the appalling mortality among our younger people from this disease. I am taking the liberty of repeating part of that letter here:

---

* 15 Grove Street, Palmer, Mass.

". . . It seems to me that even though the descriptions of the various kinds of bacteria that are present in the different manifestations of the disease are of great importance and interest from an academic standpoint, the real solution to the problem of preventing the spread of the present epidemic and the outbreak of future epidemics has not even been approached.

"The present epidemic is said by some writers to be traceable to its source in the German trenches. This is very probably true, but, on the other hand, there were a great number of cases of 'summer pneumonia' or 'camp pneumonia' reported at the various camps and cantonments in this country last summer, and I do not believe that any connection could be traced between these cases and the German trenches.

"There was, however, a condition present in the camps and cantonments in this country that was also present in the German trenches and which I believe will ultimately be found to have provided the means of propagating the disease, by whatever name it is known. I refer to the great numbers of men who have recently been inoculated with animal virus or sera in the hope of rendering them immune to the attacks of smallpox and typhoid fever.

"The established schools of medical thought will not agree with this statement, and therefore it will be difficult to produce officially published statistics to back it up at this time, but it is my firm belief that any open-minded investigator who had access to the records could soon establish the fact that, whenever a person has been inoculated with animal poison in any form, be it vaccine or anti-toxin, and the first effects have worn off, he may show an apparently increased resistance (though the reverse is often the case) to the infection corresponding to the inoculant used, but a very decreased resistance to other infections, and particularly those of pulmonary diseases.

". . . One of the reasons why this much more virulent outbreak may be traced so directly back to the German trenches probably lies in the fact that the Germans are a much more thoroughly vaccinated and re-vaccinated people than we Americans are. In Germany they start vaccinating the children before they are a year old and repeat it so regularly that by the time one of them reaches the age at which he is taken into the army, his system has become so thoroughly saturated with the products of the vaccine that he becomes a ready victim to the attack of 'grippe,' 'pneumonia,' 'influenza,' or whatever other form the disease happens to take at that particular time and place."

I believe that in those two paragraphs will be found the answer to Major Harrington's question if some one of an open mind, and who has the necessary facilities, will but take the time and put forth the necessary effort to make a thorough investigation. None will question the fact that the epidemic found its first great concentration points at the places where men of the army, navy or merchant marine were stationed. These were all men who were selected because of their physical fitness, and who could ordinarily be most depended upon to resist attacks of disease.

But — each and every one of them had recently been vaccinated, and who is there who can definitely tell us just what the effect of vaccine is upon the human system? Of course, the great number of cases of influenza at the stations mentioned made it but a matter of time until it should find its way out among the civilian population.

MEMOIR OF DECEASED MEMBER.

FRANK ALBERT PEIRCE.*

FRANK ALBERT PEIRCE was born in Taunton, Mass., May 23, 1869, the son of Oliver Albert and Sarah (Pickens) Peirce. He was elected a member of this Society September 16, 1896.

He attended the public schools of Taunton and graduated from its high school in 1886. He was in the employ of George A. King in civil engineering in Taunton during the latter part of his school life and continued with him until April, 1890, except during three months in 1886, when in the employ of the United States Geological Survey in Massachusetts.

He left Taunton in the spring of 1890 for the South and arrived in Chattanooga, Tenn., while the "boom town" fever was raging in that section and obtained employment with Nier, Hartford & Mitchell. He was in charge of surveys at Kimball, Tenn., Goshen, W. Va., and Asheville, N. C.

He established business for himself in Greensboro, N. C., in 1891, and was appointed United States surveyor in the Circuit Court, Western District of North Carolina, in 1893 and 1894. He became interested in timber land in this section and purchased several thousand acres in the mountains of southwestern North Carolina. He had charge of the construction of two large mills in Greensboro.

He was engineer for Moses and Caesar Cone, and while in their employ on a case where the question of malaria was involved, studied into the part mosquitoes play in causing that disease, a question then being actively discussed.

While carrying on business for himself he was employed at different times in the South, by C. R. Makepeace & Co., mill architects, of Providence, R. I., and they engaged him to act as inspector on work of about $900 000 in value at Lawrence, Mass. In 1901 he was appointed manager of this company's southern office, with headquarters at Spartanburg, S. C., and remained in this position about four years. During that period they constructed the Brogon Mills at Anderson, S. C., and Clifton, S. C., and additions to the Eno Cotton Mills at Hillsboro, N. C., and to the Swift Spinning Company, Columbus, Ga.

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* Memoir prepared by George A. King and Luther Dean.

About 1904, he entered the employ of T. C. Thompson & Bro., and later became a member of the firm. While with this firm they built the Hamberger Mills.

He then took up construction work as contractor, with headquarters at Columbus, Ga. Among the buildings erected by him were large mills for the Muscogee Company, the Columbus Manufacturing Company, the Swift Manufacturing Company and the Eva Jane Mill at Sylacauga, Ala.; a tank and dye house for Perkins Hosiery Mill; and a coagulating basin, filter house, and clear water reservoir of 2 500 000 gals. capacity for the Columbus City Water Works. He also built the Gordon House, one of the finest residences in Columbus, and was building an addition to the Eno Mills at Hillsboro, N. C., at the time of his death.

He died at the Watts' Hospital, Durham, N. C., August 7, 1917. Mr. Peirce never married. He was strongly attached to his mother, who survives him. He was a Republican in politics, and inherited from his Pilgrim and Scotch-Irish ancestors a strong, outspoken mind, but his sound, good sense prevented his antagonizing the prejudices of people with whom he associated.

The people of Columbus regarded him as "a good business man, and gave him their trust and confidence unreservedly"; and mill men looked upon him as one upon whom they could depend for aid in the future advancement of the South. One of those who had employed him says, "We considered Mr. Peirce an extraordinary man in his line. . . . I am sure, in every instance, owners were entirely satisfied with what he gave them."

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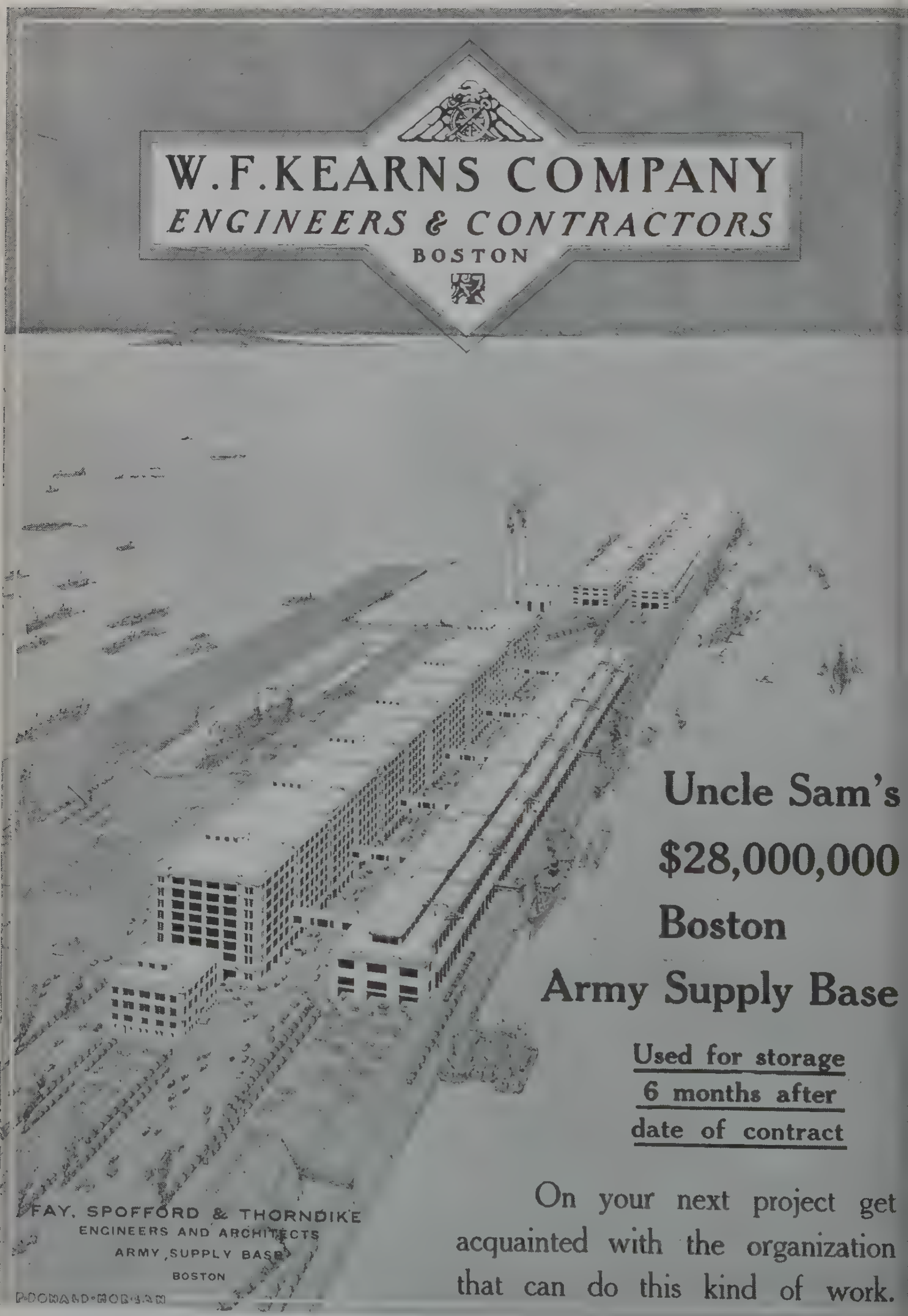

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